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Original Article

Evaluation and co-relation of lower anterior facial height and soft-tissue characteristics in between genders in North Indian population: A cephalometric study

ABSTRACT

Objective: The purpose of this study was to establish lateral cephalometric soft-tissue norms for the adolescent North Indian population.

Materials and Methods: Three hundred and thirty-three Indian adults of age group 18–30 years were selected. The standardized lateral cephalometric radiograph was taken for each subject. Fourteen linear measurements were recorded on each lateral cephalometric radiograph. Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS 26). Group differences were analyzed with independent *t*-test.

Results: The results of the study showed significant gender dimorphism, with men having thicker soft tissue structures, larger vertical dimensions, than women.

Conclusion: Significant gender dimorphism was evident within the local population suggesting the necessity for a separate set of norms for males and females. Distinct ethnic differences were found between Caucasians and the North Indian population that were statistically significant, highlighting the importance of defining separate set of norms for ethnic groups.

Keywords: Cephalometrics, lower anterior facial height, North Indian population, soft tissue thickness

INTRODUCTION

Angle was one of the first to write about harmony of the face and therefore, the importance of soft tissue. He believed that the harmony and the balance of the face depended largely on the form and the beauty of the mouth. Angle[1] wrote about facial harmony, and the importance of soft tissues, using the terms balance, harmony, beauty, and ugliness. He noted that, "the study of orthodontia is indissolubly connected thereupon of art as associated with the face,"

As treatment mechanics are getting simpler, there has been an increased emphasis on the soft tissues, both in diagnostic and treatment results. Holdaway's[2] Spradley *et al*.,[3] Bell *et al*.[4] and Owen[5,6] are among many that stress the importance of soft tissues in their diagnosis.

Holdaway[2] stated that "Usually as we correct malocclusions, we cause changes in appearance that are pleasing to all or any concerned. However, most orthodontists who have practiced for even a couple of years has the unpleasant experience of finding that some patients' faces looked better before the orthodontic corrections were made."

Holdaway's stated that "Better treatment goals are often set if we quantitate the soft-tissue features which contribute to or detract from that "physical attractiveness stereotype" which has been ingrained into our culture." The prominence of the lips and nose are important. Lip thickness, strain, and

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fullness are usually determined because the choice of dental extraction will depend on these factors in addition to facial, type, skeletal, and dental pattern.[7]

The concepts of divine proportions by Euclid and "Rule of Facial Thirds" by Leonardo Da Vinci helped in making ideal vertical facial proportions more of an objective phenomenon.[8]

Due to increasing awareness on the necessity for the treatment as patients seek to enhance their facial esthetics, a scientific understanding of anterior face proportion is additionally necessary.[9] Hence, this study aims to require of these aspects into consideration to compare the soft tissues and lower anterior facial height between two genders.

MATERIALS AND METHODS

Pre-treatment standardized digital lateral cephalograms of 333 patients between age groups 18–30 years who reported to the Department of Orthodontics in Saraswati Dental College, Lucknow (Uttar Pradesh) were taken. The duration of the study was 2 years. The sample size was estimated as per the formula based on the previous studies.[8] The participants were then finalized after checking the inclusion and exclusion criteria. Informed consent was obtained from patients regarding the purpose, procedures and possible complications of the study. All procedures performed in this study involving human participants were in accordance with the ethical standards of the Institutional Human Ethics Committee, Lucknow.

Inclusion criteria

- Age between 18 and 30 years
- Angle's Class I malocclusion
- All intact permanent dentition
- No significant medical history
- No history of facial cosmetic surgery or orthognathic surgery.

Exclusion criteria

- Previous history of treatment
- Cranial or facial malformation, and history of craniofacial trauma.

Pretreatment standardized digital lateral cephalograms of 333 patients were taken with the teeth in centric occlusion and Natural Head Position (NHP). While recording the lateral cephalograms, the patients were placed in the standing upright position and asked to seem directly into the reflection of their eyes during a mirror directly ahead within the middle of the cephalostat.[10] The Frankfort Horizontal plane was parallel to the floor and the teeth in centric occlusion. The head of the patients was fixed by the two ear rods. The head was erect and centered within the cephalostat, which was oriented to the cassette in Natural Head Posture, NHP.

All the cephalograms were recorded with equivalent exposure parameters (KvP – 80, mA-10 exposure time 0.5 s) with ×100%, and therefore, the same machine (Kodak 8000C Digital and Panoramic System Cephalometer Rochester).

The X-rays were printed using Fujifilm medical dry imaging film (8 × 10 inches in size) and, therefore, the Fujifilm dry pix plus printer. These cephalograms were hand traced employing a sharp 4H pencil on acetate paper using an X-ray viewer. All the relevant structures and landmarks were marked [Figure 1].

RESULTS

To control the errors in tracing and analysis, Dahlberg's[11] formula was applied. A master file was created, and therefore, the data were analyzed using SPSS software (version 26, IBM, USA). Group differences were analyzed with independent *t*-test.

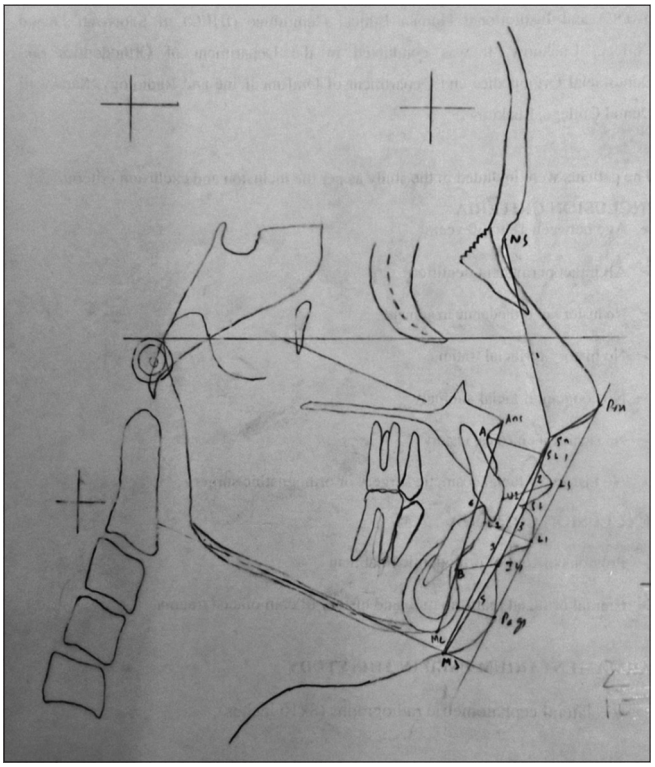

Figure 1: Various cephalometric reference points and lines used in this study. The horizontal soft-tissue measurements; (1) Anterior nose depth. (2) Soft-tissue thickness at point A. (3) Soft-tissue thickness at labrale superius. (4) Soft-tissue thickness at labrale inferius. (5) Soft-tissue thickness at point B. (6) Soft-tissue thickness at pogonion. (7) Upper lip to E-line. (8) Lower lip to E-line. The vertical soft-tissue measurements; (1) Upper facial height. (2) Upper lip height. (3) Lower lip height. (4) Chin height. (5) Lower facial height. (6) Skeletal lower anterior facial height

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When mean values of soft tissue variables of males and females were compared [Table 1] Anterior nose depth (Sn–Prn), Soft tissue thickness at point A, Soft tissue thickness at point B (B–Ils)., Soft tissue thickness at pogonion point, Upper lip thickness at labrale superius and Lower lip thickness at labrale inferius were found significant. The soft-tissue parameters Upper facial height (Ns–Sn). Upper lip height (Sn–St), Lower lip height (St–Ils), Chin height, lower facial height (Sn–Ms), Lower anterior facial height (hard tissue) (ANS-Me) is additionally significant between males and females. However, no significant difference with respect to gender was seen within the upper lip and lower lip E-line. Results for comparing variables among the genders of facial types are presented in Table 1.

DISCUSSION

Facial esthetics is taken into account as one of the most goals of treatment, and increased emphasis has been placed thereon in recent years by both patients and orthodontists since the soft tissue outline largely determines the esthetics of the entire face.[12] Anwar *et al*.[13] stated that vertical facial form is a crucial element of orthodontic assessment. Large variations are found within the vertical dimension, and these affect the clinician's approach to successful diagnosis, treatment planning, and mechanics.

Table 1: Group statistics independent *t*-test with respect to gender for the various parameters

	Gender	*n*	Mean	SD	SEM
Sn-Prn	Male	115	16.8783	2.24838	0.20966
	Female	218	15.7696	2.05760	0.13968
Point-A	Male	115	16.0435	2.11258	0.19700
	Female	218	13.3257	1.74646	0.11829
Point-B	Male	115	12.4435	2.26410	0.21113
	Female	218	11.0734	1.82762	0.12378
Pogs	Male	115	11.7739	2.68544	0.25042
	Female	218	10.7752	1.76236	0.11936
Ls-U1	Male	115	13.0696	2.49463	0.23263
	Female	218	11.6881	1.98472	0.13442
UL-E line	Male	115	−1.2609	2.67243	0.24921
	Female	218	−1.6193	2.55393	0.17297
Li-L1	Male	115	15.5478	2.32169	0.21650
	Female	218	13.4633	2.10355	0.14247
LL-E line	Male	115	1.3130	4.67799	0.43622
	Female	217	0.8756	4.18974	0.28442
Ns-Sn	Male	115	47.7304	4.81832	0.44931
	Female	218	45.0780	4.85821	0.32904
Sn-St	Male	115	20.6000	2.74277	0.25576
	Female	218	18.6147	3.13861	0.21257
St-Ils	Male	115	15.8783	2.86279	0.26696
	Female	218	14.8991	2.27162	0.15385
Ils-MS	Male	115	32.7217	4.55675	0.42492
	Female	218	29.0046	4.17199	0.28256
Sn-Ms	Male	115	68.7739	8.44181	0.78720
	Female	218	62.4954	7.49208	0.50743
Ans-Me	Male	115	63.5130	4.80016	0.44762
	Female	218	58.0642	4.88914	0.33113

SD: Standard deviation, SEM: Standard error of the mean

Sn-Prn value showed gender dimorphism ($P = 0.000$). This disagrees with the results of Abdul-Qadir *et al*.[12] too reported an insignificant difference between the genders. This will be attributed to the variation in sample size, location, and therefore, the ethnic origin that was taken in the study.

Similar to Sn-prn, Point A showed gender dimorphism with males exhibiting a greater value (16.043) than their female (13.325) counterpart. These results were in accordance with Taki *et al.*,[14] Abdul-Qadir *et al*.,[12] Basciftci *et al*.[15] and Blanchette *et al*.[16]

Males exhibited higher lip thickness at point B (12.44 mm) than females (11.073 mm). This was against the work done by Abdul-Qadir *et al*.[12] and Blanchette *et al*.[16] This will be attributed for variation in sample sizes and allocation.

Pogs value showed gender dimorphism with male exhibiting higher value (11.773 mm) than female (10.775 mm). This result was in congruence with Al-Mashhadany *et al.*[17] and Subramaniam *et al.*,[18] Al-Mashhadany *et al*.[17] cited the testosterone effect in facilitating the synthesis of collagen that provide males with skin, on the opposite hand, the estrogen hormone in females facilitates the synthesis of hyaluronic acid additionally to the decreasing within the synthesis of collagen making their skin thinner. However, Abdul-Qadir *et al*.[12] stated there was no significant difference between genders.

Upper lip thickness at Ls did show gender dimorphism, with males having thicker lips than females. This was supported by Cezairli,[19] Abdul-Qadir *et al*.[12] and Al-Mashhadany *et al*.[17] Al-Mashhadany *et al*.[17] stated that testosterone effect in facilitating the synthesis of collagen that provide males with skin, on the opposite hand, the estrogen hormone in females facilitates the synthesis of hyaluronic acid in addition to the decreasing within the synthesis of collagen making their skin thinner. However, the results of the study done by Blanchette *et al*.[16] was contrasting. They stated there was no significant difference in upper lip thickness between males and females.

Lower lip thickness at Li was found to be statistically significant between males (15.54 mm) and female with male (15.547 mm) exhibiting higher value than their female (13.463 mm) counterpart. This was accordance with

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the results of the studies done by Al-Mashhadany *et al*.[17] and Abdul-Qadir *et al*.[12] Moreover, Abdul-Qadir *et al*.[12] stated that long face males revealed significantly greater dimension than female.

Both UL-E line and LL-E line did not show gender dimorphism. The results were in congruence with the work done by Abdul-Qadir *et al*.[12] and Hashim and AlBarakati.[20] However, Erbay *et al*.[21] stated that both lips where protrusive in (female) than in males. They pointed out that this could be due to the significantly smaller SNB angles and significantly greater mandibular angle in the female. An interesting statistics was noted on comparing the relation of the upper and lower lip with E line. Erbay *et al*.[21] cited that this was due to the downward and backward mandibular rotation.

Upper facial height show did show gender dimorphism with males having a greater (47.7 mm) than their female's counterpart (45.07 mm). Congruent to the present result was the work done by Abdul-Qadir *et al*.[12]

Upper lip height showed a big difference between the genders with males participants having increase value (20.06 mm) than their females counterpart (18.61 mm). Supporting this result was work done by Kalha *et al*.[22] However, Abdul-Qadir *et al*.[12] and Blanchette *et al*.[16] reported that gender dimorphism was more for lower lip height than upper lip height.

Lower lip height also showed a gender dimorphism with males shows a higher value than females. This was supported by Abdul-Qadir *et al*.,[12] Blanchette *et al*.[16] and Kalha *et al*.[22]

On comparing with gender, chin height showed a significant difference, with males having a higher value than females. This was supported by Abdul-Qadir *et al*.,[12] Kalha *et al*.,[22] and Reveiro *et al*.[23]

Soft-tissue lower facial height showed gender dimorphism with males showing a greater value than females. This was supported by Abdul-Qadir *et al*.[12] and Kalha *et al*.[22] They stated that the increased lower lip length because of the possible reason for supporting a better value for males.

Similar to soft-tissue lower facial height, the skeletal lower anterior facial height also exhibited a big difference between the genders. Gender dimorphism was shown with males exhibiting higher value for females. This was supported by Anwar *et al*.[13]

These findings show that group-specific norms are an important prerequisite for the accurate evaluation of orthodontic patients. The most advantage of this study is giving standard lateral soft-tissue cephalometry measurements for North Indian people in both genders, helping in diagnosis and treatment plans for orthodontic and surgical decisions and improving posttreatment outcomes.

The limitation of this study was the selection of class-I molar and canine relation and exclusion of the classes of malocclusion. Another limitation was it gives a two-dimensional view of the three-dimensional object.

The conventional cephalometric approach encounters several limitations. Cone-beam computed tomography (CBCT) offers the likelihood of accurate localization and quantification of even minor asymmetries without distortion and hence much more precise cephalometric analysis. Within future, we can extend our study to a broader geographical area and use the latest CBCT technology to offer more precise quantitative data to represent the norms.

CONCLUSION

All the soft-tissue values except the upper lip and lower lip to E-line had significantly higher value for males. The effects of testosterone facilitating the synthesis of collagen provided males with thick skin, whereas the hyaluronic acid synthesized by estrogen hormone decreased the synthesis of collagen, thereby providing the female counterpart a thinner skin.

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Conflicts of interest
There are no conflicts of interest.

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